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A MAGGOT TRAP IN PRACTICAL USE; AN EXPERIMENT IN HOUSE-FLY CONTROL.

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INTRODUCTION.

During the season of 1913 experiments were carried out independently by Levy and Tuck at Richmond, Va., by C. G. Hewitt at Ottawa, Canada, and by the writer at Arlington, Va., and New Orleans, La., all of which agreed in demonstrating a most pronounced migratory habit in house-fly larvæ just before pupation. It was found very easy to trap them at this particular stage of their development, and experiments with small maggot traps showed that as high as 98 or 99 per cent of the larvæ could be caught. At the suggestion of Mr. W. D. Hunter the writer has made an attempt during the past season to apply the principles of the maggot trap to practical use and to test its efficiency when used to destroy the maggots in large masses of manure. In this article are reported the results obtained from experimental work along this line, conducted at the Maryland Agricultural College at College Park, Md. Dr. H. J. Patterson, president of the college and director of the experiment station, has been most generous in his cooperation in this work, and through him the materials and labor for the construction of the trap were supplied. The writer wishes also to acknowledge the helpful suggestions of Profs. T. B. Symons and E. N. Cory, of the college.

LOCAL CONDITIONS WITH REGARD TO FLY PREVALENCE AND BREEDING PLACES.

The college was selected as a suitable place for conducting the experiment, partly because the conditions with regard to breeding places for flies seemed such that it would be easy to determine whether or not the maggot trap was effective. The college is some-

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Note.—This bulletin describes the operations of a maggot trap based on the migratory habit of house-fly maggots just before pupation. It will be of interest to all farmers and to those industries in which the accumulation of refuse may encourage the propagation of the house fly.

what isolated by its position on a hill and separated a considerable distance from any near-by stables. On the accompanying map (fig. 1), which has been adapted from a map of the Geological Survey, is shown the topography of the surrounding section. The location of only two of the college buildings is given, viz, the college kitchen (K) and the stable (S). The college kitchen, by reason of odors from cooking and the presence of large quantities of garbage kept in iron pails just outside the door, attracted extremely large numbers of flies. One could not approach these garbage pails without stirring up a noisy swarm which had congregated there. However, no flies were breeding out from this garbage, for the reason that it was

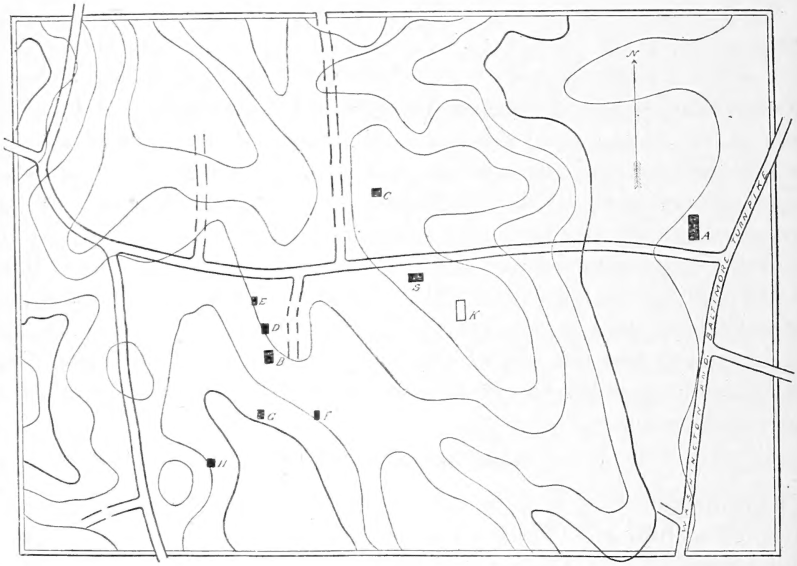


FIG. 1.—Map of vicinity of the Maryland Agricultural College showing the location of the college kitchen (*K*), the stable (*S*), and the proximity of other breeding places of flies (*A*, *B*, *C*, *D*, etc.) (Original.)

entirely removed every two or three days and taken to a near-by farm, where it was fed to hogs.

The breeding ground nearest to the kitchen was the pile of manure heaped just outside the college stable. This is nearly 200 yards northwest of the kitchen. It is probable that a large majority of the flies at the kitchen came from this source. Upon examination at various times during June and July the fresher portions of this heap were always found heavily infested with larvæ. Puparia were also found in great abundance in the loose soil and in the manure at the periphery of the pile. Three horses were kept in this stable, and two of them were standing in the stalls during the greater part of each day. Flies were also very numerous in and about the stable, and during the day the horses were continuously tormented by them.

With the exception of the college stable, there were no breeding places for flies within 400 yards of the kitchen. The stable, indicated by the letter C on the map, is approximately 400 yards from the kitchen and about 200 yards from the college stable. Other stables are located some 400 to 500 yards west of the college stable, the distance from the kitchen being about 100 yards greater.

Another extensive breeding place was found in the large collections of manure at the barns of the experiment station, located about 700 yards northeast of the college. This is indicated on the map by the letter A.

PLAN OF EXPERIMENT.

With these conditions prevailing, it was planned to construct a maggot trap large enough to take care of the entire manure production at the college barn, with the idea that if the trap proved effective there should appear a marked decrease in the prevalence of flies, not only at the barn but at the college kitchen. To determine whether or not the trap was effective the following three lines of observation were undertaken: (1) By collection and careful estimate of the larvæ caught by the trap and subsequent search for puparia in the manure, to get some idea of the percentage destroyed; (2) by making numerous fly counts during the season to find out whether the prevalence of flies at the kitchen and stable was decreased; and (3) to determine whether any of the flies at the college came from nearby breeding grounds (A, B, C, etc.) other than the manure heap at the college stable.

THE MAGGOT TRAP.

The maggot trap used in this experiment was designed and constructed as follows. First, a concrete floor was prepared 22 feet long and 12 feet wide. Around this floor was a rim or wall of concrete 4 inches high and 4 inches thick. An outlet pipe 4 inches in diameter was fitted in one corner toward which the floor sloped a little so that water would run out easily. Water was retained in the concrete floor by stopping the pipe outlet with a plug of soft wood. The pipe outlet led to a small cistern 5 feet square and 4 feet deep, the walls and floor of which were made of concrete. Standing on the floor of the concrete basin was constructed a wooden platform 20 feet long and 10 feet wide, supported on legs 1 foot high. The framework of the platform was made of 2 by 4-inch studding. There were 6 of these pieces running lengthwise 2 feet apart, and one fastened across each end. Each of the long pieces was supported on four legs set at intervals of nearly 7 feet. Across the top of the framework were nailed strips 10 feet long by $1\frac{1}{4}$ inches thick and 1 inch wide. These strips were nailed 1 inch apart. Plate I shows most of the details of construction. Plate II gives another view, including also the outlet pipe (in this case consisting of 4-inch terra cotta) and the pump in place over the cistern. On account of various obstructions it was necessary to place the cistern some distance away from the trap, although, as will be pointed out later, it is desirable to have the cistern close to the trap and the pump so arranged as to return the contents of the cistern to the manure heap on the platform.

THE METHOD ADOPTED IN USING THE MAGGOT TRAP.

The maggot trap was put into operation on July 25. On this date the manure pile which had accumulated in front of the barn during June and July was hauled away and spread on the fields, so that, beyond the hatching out of the pupæ and larvæ already present, it ceased to exist as a breeding ground for flies. On and after July 25 each day's production of manure was heaped on the platform. Beginning at the end farthest from the barn door, the manure was piled up to a height of from 3½ to 4 feet. The heap was maintained at about this height, and with the daily additions it kept increasing in length. Plates I and II show the appearance of the heap after a little more than four weeks' accumulation. The platform was found large enough to hold a little more than two months' production of manure from three horses and could easily have been made to hold the total production for three months by making the pile higher. Each day, after the addition of manure and litter from the stable, the manure on the platform was sprinkled with enough water to moisten it thoroughly without causing any leaching. Water was run into the concrete basin below the platform, so that the floor beneath the manure was covered to a depth of ½ inch in the shallowest part. Larvæ migrating from the manure dropped into the water below and were drowned.

At least once a week, and sometimes oftener, the water was drawn off from the basin into the cistern and the floor was washed clean by a strong stream of water from a hose. The larvæ which had fallen into the water, together with the débris which had sifted through the platform or fallen from the sides, were collected at the cistern end of the outlet pipe in a strainer. The matter thus retained in the strainer was then spread out on a smooth concrete surface near by, and the number of larvæ present was carefully estimated. The outlet was then plugged, and the basin again partly filled with water by pumping back what had run into the cistern.

THE PERCENTAGE OF MAGGOTS DESTROYED.

Without going into details of the weekly or biweekly counts, it will be enough to state that during the period from July 25 to October 1 a total of about 112,000 dead larvæ were collected in this way.

But this number does not represent all that dropped out of the manure into the water below. A flock of young turkeys roamed at large during the summer over the college grounds and adjoining fields. Having once found the maggot trap they made frequent visits and were seen to devour the larvæ with great avidity, sometimes completely clearing the floor except where the water was more than 2 or 3 inches deep or when it was so badly discolored as to conceal the larvæ. Sparrows also were seen frequently on this floor, but one could never get close enough to see whether they actually devoured any larvæ or not. It is more than likely that they did. The actual number of larvæ which were destroyed by the maggot trap was undoubtedly much greater than 112,000.

After October 1 the writer and an assistant examined all the manure on this platform in search of puparia. The manure was thrown off, a few bushels at a time, onto a smooth concrete surface near by and very carefully examined, all straw being shaken out and all solid parts being finely broken up. In a very literal sense this was like looking for a needle in a haystack. A few scattered puparia were seen in various parts of the heap, but in only two spots were they to be found in the characteristic clusters or "nests" which can be found so readily at the edges of manure piles on the ground. These two nests were found at the end of the platform where the most recent additions had been made. The manure at this end had not been sprinkled with water after the day it was put on. Failure to keep this moist as long as larvæ were present is, in the writer's opinion, the explanation of the pupation in this part. One nest contained about 400, and the second about 700 puparia. Allowing for some that may have escaped notice, the number of puparia may be given in round numbers as 1,500. No larvæ whatever were found in any part of this heap, the oldest part of which had been on the platform for two months, and even the freshest portion of which had been standing for at least 10 days before it was examined. If, then, 1,500 represents the total number which pupated in the manure and 112,000 the number which was destroyed by drowning, it shows a percentage destruction of about 98.5 per cent of the possible total. This is illustrated in figure 2, above. Taking into account the larvæ devoured by turkeys, etc., it is probable that the effectiveness of the trap could be rated as above 99 per cent.

In a former bulletin the claim was made that manure will be practically free from maggots after standing 10 or 12 days. Special attention was given to this point during the course of the experiment, and all observations tended to support the claim. Moreover, there was no evidence that larvæ ever migrated from the fresher portions of the manure to the older parts to pupate. That old manure does not serve as a breeding place for flies is a point that deserves some emphasis entirely aside from its bearing on the practical use of the maggot trap. The explanation is probably to be found in the changes which take place in the manure heap during storage. As the pile stands it settles considerably, with a consequent decrease of air spaces, and, especially if watered, air does not penetrate far below the surface. Dehérain and Dupont (1900) have shown that in manure well heaped so that air can not penetrate readily, the confined gases consist largely of carbon dioxid and methane, and that oxygen is not found except near the surface. It may well be that the lack of oxygen and the abundance of carbon dioxid render old manure unfavorable for the breeding of flies. It may also be that the composition of the gases in the manure is one of the factors which influence migration and the choice of a place for pupation.

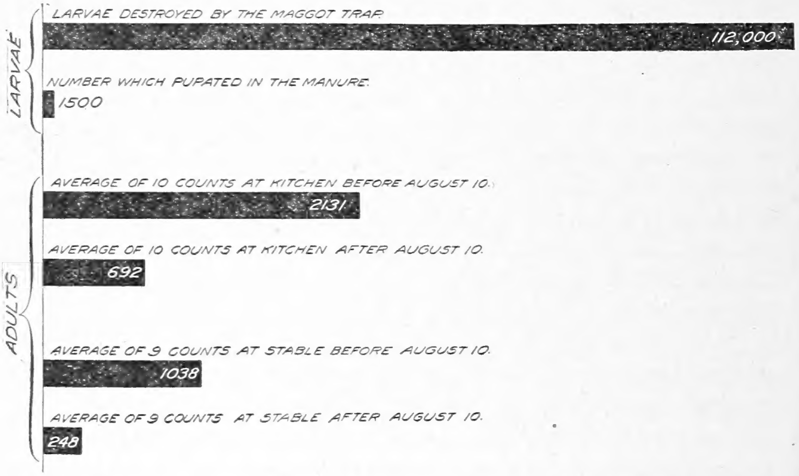


FIG. 2.—Graphical representation of the work of the maggot trap and its effect on the prevalence of flies. (Original.)

EFFECT ON THE FLY PREVALENCE AT THE STABLE AND KITCHEN.

Turning now to the second line of observation, it will be of interest to determine to what extent the maggot trap influenced the number of flies at the stable and kitchen. An answer to this is to be found in the series of fly counts made during the season, both before and after the trap was started. In taking these counts "tanglefoot" sticky fly paper was used. The papers were exposed for 24-hour intervals and counted immediately at the end of that period. Figure 3 is a graphic representation of these series of counts at the stable and kitchen. In each case the number given is the total caught on two papers exposed at the same time. At the kitchen the two papers were always exposed in the same way on top of the garbage pails, and at the stable one paper was put on the floor just outside the door and the second just inside the door, which faces the east. On several occasions papers were exposed, but the counts are not given in the diagram for the reason that a shower of rain or a strong wind spoiled some of the papers. The numbers which are plotted are those obtained on clear, warm days, on which the climatological conditions were nearly the same except for the direction of the wind. This will account for the irregular time intervals between the successive counts.

It is recognized that this method is not all that could be desired as an accurate index of fly prevalence. The use of a small number of fly papers in this way is nothing more than a method of sampling, but since the papers were exposed always in the same places and under nearly the same climatological conditions, the method may be considered as reliable as any method of sampling used in other lines of

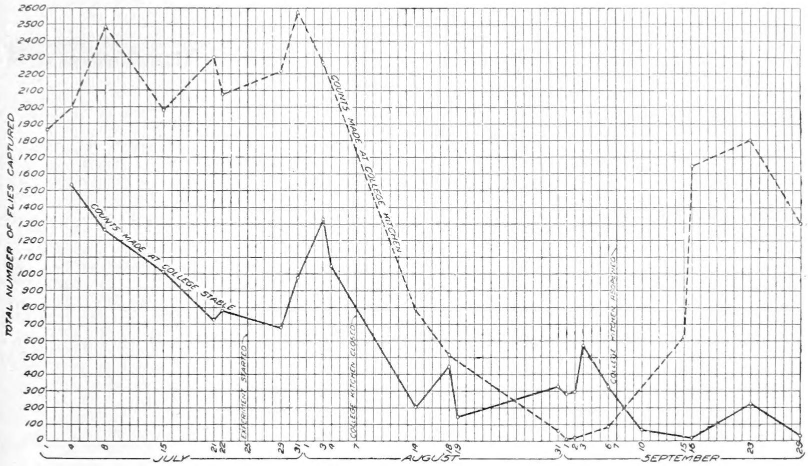


FIG. 3.—The broken line connects series of fly counts at the garbage pails near kitchen; the solid line, those at the stable. (Original.)

work. The use of a few fly papers in this way would not of itself have any appreciable effect on fly prevalence. It was thought that the use of fly traps would complicate the situation in that any apparent reduction in the number of flies might be ascribed to their use rather than to the maggot trap.

A study of the fly counts shown in figure 3 reveals that there was a decided drop in the number of flies both at the kitchen and stable very shortly after the maggot trap was put into operation. Assuming that all the flies at the stable and kitchen at the time the experiment began (July 25) were freshly emerged and that they would all die off within three weeks (there is some evidence that flies seldom live longer than this in midsummer), one would expect to find a reduction in the number of flies about August 10 or 12. As a matter of fact this is what occurred. Although the counts fluctuate considerably after this date, in no case do the highest counts rise to the level of the lowest counts made before August 10.

In one respect these counts hardly give a fair indication of the effect of the maggot trap, this for the reason that the college kitchen was closed from August 7 to September 7. It will be seen that flies almost completely disappeared from the kitchen during the latter part of August, but as soon as the garbage pails were again in use the fly counts go up fairly high, although not as high as the lowest count at this place before the experiment started. It is interesting to note that while the kitchen was closed the fly counts at the stable were somewhat increased and that after the kitchen reopened the flies almost disappeared from the stable. Taking the counts at the kitchen, we find that the average of the 10 counts before August 10 is 2,131, while the average of the 10 counts after August 10 is 692, an average reduction of 67.5 per cent. At the stable the average of 9 counts before August 10 is 1,038, and the average of 12 counts after August 10 is 248, an average reduction of 76 per cent.

The behavior of the horses standing in the stalls was also a fairly good index of fly prevalence in the stable. As noted above, the horses were constantly tormented during June and July. During the day the stamping of feet and switching of tails was incessant. After the maggot trap had been in operation for some time there was a noticeable change. The horses stood much more quietly, and their efforts to get rid of flies were less continuous. Several men at the college observed this and volunteered the information.

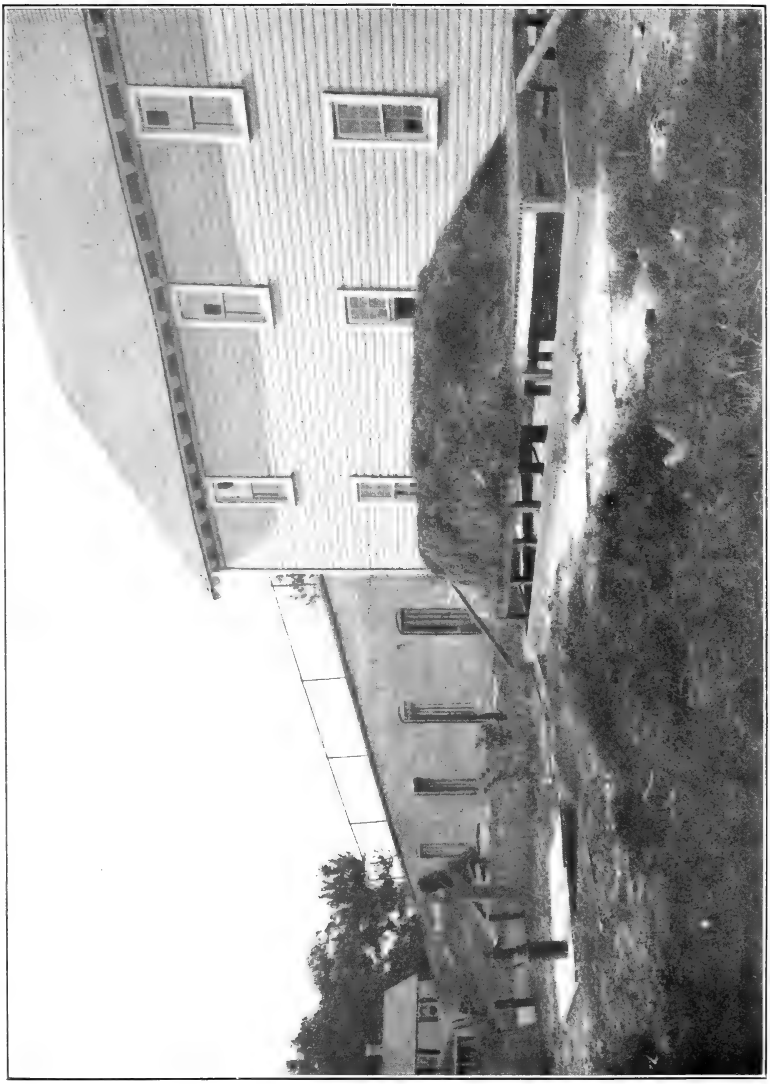
INFLUENCE OF OTHER BREEDING PLACES ON THE NUMBER OF FLIES AT THE COLLEGE.

If the maggot trap was really destroying 98 per cent of the flies breeding in the manure at the college stable, why is there not a corresponding reduction in the number of adult flies instead of an average reduction of from 67 to 76 per cent? The third series of observations points to a probable explanation of this. As indicated on the map, there are several breeding places within 700 yards of the college, and 700 yards is well within the range of flight of flies, a fact which has been proved by several workers. A few flight experiments with marked flies were carried out during the season, not with the idea of determining the range of flight, but merely to make sure whether or not flies from these various breeding places found their way to the college stable and kitchen.

First, about 600 recently emerged flies were thoroughly dusted with finely powdered red crayon and liberated on August 31 at a point near the stable indicated by the letter B (fig. 1). The point of liberation was about 400 yards west of the college stable and perhaps 500 yards from the kitchen. In spite of the presence of several houses

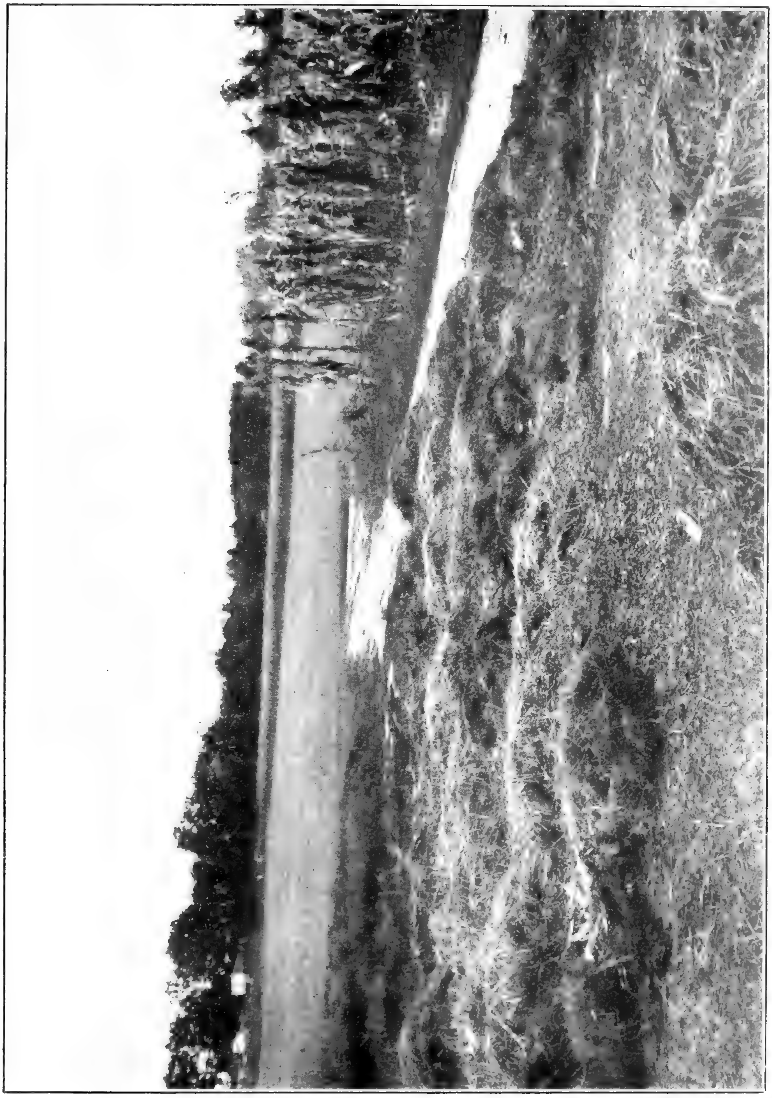
A MAGGOT TRAP FOR HOUSE-FLY CONTROL.

View of the maggot trap, showing the concrete basin containing water in which larvæ are drowned, and the wooden platform on which manure is heaped. (Original.)



A MAGGOT TRAP FOR HOUSE-FLY CONTROL.

Another view of the maggot trap, showing the pipe leading to the small cistern, and the pump used to force water back to the concrete basin. (Original.)



UNDESIRABLE CONDITIONS WHICH ARE OVERCOME BY USE OF THE MAGGOT TRAP.

A manure pile covering a large area and having little depth. Illustrating the conditions which favor the greatest loss of nitrogen, and at the same time offer the best breeding ground for flies. (Original.)

and stables in the immediate vicinity, some of these marked flies found their way to the college barn. Here two of this lot were recovered within the first 24 hours, and a third one during the third 24-hour period. That no flies were recovered at the kitchen is to be explained by the fact that the kitchen was closed and there was nothing there to attract flies.

A second lot of about 500 flies, sprayed with rosolic acid, were liberated at the dairy barn (A) of the experiment station, 700 yards due east from the college stable. The distance from the kitchen is slightly less. They were liberated at 3.30 p. m. September 1. On September 3 two marked flies were found on papers exposed at the dairy barn, but none was recovered at the college stable or kitchen. A strong southwest wind was blowing at this time and may have had some influence on the result. It is hardly to be doubted that when the kitchen is in use numbers of flies from this source are attracted to it. The manure pile back of the dairy barn was found to be heavily infested at all times during the summer, and flies bred out here by the thousands.

In a third experiment about 800 flies marked with powdered red crayon were liberated on September 15 at the stable marked by the letter C (fig. 1). Within the first 24 hours 11 marked flies were recovered on fly papers at the garbage pails, and two more during the second 24-hour period after liberation. No marked flies were recovered at the college stable in this experiment. The kitchen was in use at this time, and it must be considered significant that the flies were recovered only at the kitchen, although they had to pass right by the stable. This indicates the sharp rise in fly counts at the kitchen when it reopened in September.

The same thing happened on September 22. A lot of about 600 flies sprayed with rosolic acid had been liberated on September 21 near the stable marked on the map by the letter D (fig. 1). None of these were recovered at the college stable, but three were found within the first 24 hours on papers exposed on the garbage pails at the kitchen.

These few experiments indicate that a large number of the flies which congregate at the college kitchen and stable come from near-by breeding grounds other than the manure pile at the college barn. And it may be said that a reduction of from 67 to 76 per cent in the average number of flies, in spite of the proximity of these other breeding places, speaks well for the efficiency of the maggot trap.

SOME DEFECTS OF THE MAGGOT TRAP.

The experience during the past season with the platform maggot trap has directed attention to certain defects in its practical working. These defects, however, are not of such a serious nature that they can not be overcome. In the first place, some trouble resulted from smaller particles of manure sifting through between the cross strips and accumulating in the water below. This was especially the case when sawdust and shavings were used for bedding instead of straw. If this material were allowed to accumulate there would finally be enough of it to provide a breeding place on the concrete floor, where the maggots should be killed by drowning. Much of this sifting could be prevented by placing the cross strips closer together, so that only ½-inch or even ¼-inch spaces were afforded. It is not at all likely that ¼-inch spaces would interfere with migration; but in spite of such improvement there would be, even with the most careful handling, a certain amount of straw or small particles of manure which would fall from the sides of the heap or from the fork at the time it was put on the platform. It will always be necessary to clean out the concrete floor more or less regularly, and for this purpose a long-handled stable broom will be satisfactory when the water supply does not permit the use of a strong stream from a hose. To facilitate the cleaning of the floor the platform should not be less than 1 foot high nor more than 10 or 12 feet wide. The solid matter which happens to be washed into the cistern will decompose in time and be pumped back with the liquid onto the manure heap.

In dry weather evaporation of the water on the concrete floor will leave large areas of floor surface dry. Larvæ falling from the manure above onto the dry floor will crawl away and can crawl up the vertical sides of the surrounding rim; in fact, they could crawl up this surface even if it were as smooth as glass. To insure that all larvæ are drowned it is necessary to keep this in mind, and every day, when the manure is added to the heap, more water can be supplied if necessary. This operation will consume very little time.

The most serious defect was found in the fact that mosquitoes bred very freely in the water standing in the concrete basin and in the cistern. In order not to have one pest multiplying at the expense of another, it is necessary to run all water out of the concrete floor at least once a week and to clean the floor at this time; if then a little oil is poured over the surface of the liquid in the cistern, mosquito breeding will be prevented entirely. This method was used during the last weeks of the experiment with satisfactory results. If the cistern were carefully and tightly covered, perhaps the use of oil would not be necessary.

No counts or estimates were made of the larvæ destroyed during October and November. It is known, however, that larvæ continued to appear in the water on the floor during the most of October and during the warmer parts of November. On December 10 the manure was examined without removing it from the platform, and therefore not as thoroughly as on the former occasion, but there were found at the fresher end of the pile at least four nests of several hundred puparia each. It is not possible to estimate the percentage destroyed, but it was quite plain that the trap was not as effective during the autumn as in the summer. This may have been due partly to carelessness in the matter of watering the heap, but more probably to the lower air temperatures of this period. When the outside temperature is low, the difference between the air and the temperature of the manure heap is so great that the larvæ will not leave the heap; and if the low temperatures prevail for a long period the larvæ will eventually pupate in the manure. The following experiment shows the effect of low air temperature. This experiment was conducted at New Orleans, La., in December, 1913. A small wire basket was filled with fresh horse manure on December 1 and was continually exposed to flies. The number of larvæ caught and the temperature during the period are tabulated below.

Experiment to show effect of low air temperature in preventing migration of house-fly larvæ, New Orleans, La., December, 1913.

	Number of larvæ caught.	Minimum temperature.	Maximum temperature.	Mean temperature.
		° F.	° F.	° F.
Dec. 2	12	57	74	65.5
3	15	56	67	61.5
4	47	57	68	62.5
5	199	56	73	64.5
6	745	57	70	63.5
7		48	61	55
8	[1] 4,000	40	61	55
9	0	32.5	50	41.7
10	1	34.5	56	45.3
11	43	38	59	48.5
12	465	41	65	53
13	[1] 900	47	68	53
14		58.5	73	65.8
15	[1] 700	49	66	57.5
16	115	50	62.5	56.2
17	185	52	69	60.5
18	160	55.5	60	57.8
19	32	51	58	54.5

[1] Approximate. Counts of Dec. 8 and 15 include catch of preceding day.

Probably most of those that were caught on December 8 had migrated during the night of December 6. Not much migration from the manure takes place during the day, because of the maggots' negative reaction to light; therefore the minimum temperature is probably more significant than the daily mean temperature. It will be seen from the table that minimum temperatures of 40° F. or less will stop all migration from the heap.

It may be said, then, that the maggot trap has another defect in that it is not effective when temperatures are low, and that it is not at all effective when the air temperature is below 40° F.

SOME ADVANTAGES OF THE MAGGOT TRAP.

Some of the advantages of the maggot trap are obvious enough and need be only briefly mentioned here. It is an exceedingly simple arrangement, and the initial cost of construction need not be very great. Once having been constructed, no continuous money outlay for its maintenance is necessary. The concrete parts are permanent, and the wooden platform would require renewal only at intervals of several years, depending partly on the kind of wood used. The writer is of the opinion that in the long run the maggot trap would be less expensive than the investment which many farmers now make in screens for their dwellings and repellents, sprays, and fly nets for the protection of their animals.

The labor required in the operation of the maggot trap is a very small item. It is just as easy to place the manure on the platform as to dump it on the ordinary pile. It requires only a few minutes each day to see to it that the daily addition is carefully and compactly heaped and the entire heap well moistened. The work of cleaning out the floor below the platform will require about one-half an hour once a week.

It is very easy to run a wagon or manure spreader close alongside the maggot trap, as a glance at the photographs will show, and it would be just as easy, or indeed easier, to load from such a platform than from the ground. To facilitate loading as well as the cleaning of the floor below, the platform should be no more than 10 or 12 feet wide.

The maggot trap can be adapted for use on farms where the daily production of manure is very great. As was stated on a preceding page, the trap used in this experiment would hold the total production from three horses for three months. Now the problem of constructing a trap of reasonable size to take care of the manure of 40 or 50 horses is not as hopeless as might at first appear. The production of manure per horse per day may be safely estimated at 2 cubic feet. It will be seen that a platform 10 by 20 feet would hold manure produced by 50 horses during a period of 10 days if the heap is made 5 feet high. If two platforms are arranged as suggested in figure 4 they could be operated as follows: Platform No. 1 would be gradually filled up during the first 10 days; then, while this remains on the platform, the manure produced during the second 10 days would be placed on platform No. 2; at the end of 20 days the manure on platform No. 1 would be hauled away and the platform refilled during the third 10-day period while heap No. 2 was standing the length of time required to rid it of maggots. In this way the two piles would alternate, the one being in the process of formation and the other standing till practically all maggots had left it. It would be convenient, as indicated in the diagram, to have a cistern located between the platforms and a pump that could be used in applying water to both piles. In making plans for a maggot trap one must take into consideration the volume of manure produced and the length of time it must remain on the platform. As previously stated, it will be safe to estimate that the production of manure per horse per day is 2 cubic feet and that after 10 days it will be practically free from maggots, provided it has been well watered.

THE INFLUENCE OF THE MAGGOT TRAP ON THE VALUE OF THE MANURE.

Plate III illustrates an all-too-common method of keeping manure. It covers a large area of ground, and no attempt at heaping has been made. The manure in such a pile is loose and shallow, and air penetrates into practically all parts. These are the conditions

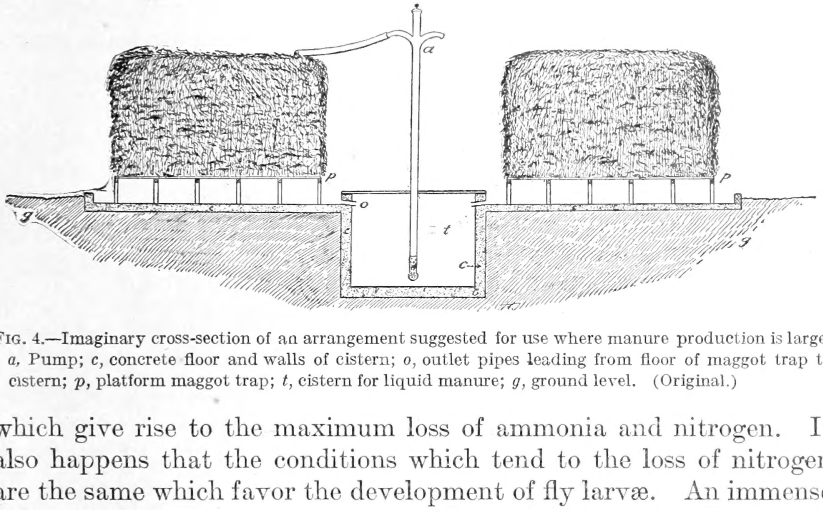


FIG. 4.—Imaginary cross-section of an arrangement suggested for use where manure production is large. *a*, Pump; *c*, concrete floor and walls of cistern; *o*, outlet pipes leading from floor of maggot trap to cistern; *p*, platform maggot trap; *t*, cistern for liquid manure; *g*, ground level. (Original.)

which give rise to the maximum loss of ammonia and nitrogen. It also happens that the conditions which tend to the loss of nitrogen are the same which favor the development of fly larvæ. An immense surface is exposed for deposition of eggs, and the penetration of air makes it possible for larvæ to feed in practically all parts. The fresher portion of the manure shown in this photograph was found heavily infested all through the season.

It has been shown that the losses occurring in manure thus carelessly stored will vary from 30 to 64 per cent of the total amount of nitrogen (Beal, 1906), and that by careful methods of storage this loss may be reduced to 15 per cent. Several methods of storage for the purpose of preventing loss of ammonia and nitrogen have been proposed. Among others is that recommended by Dehérain, Beal, Thorne, Ringelmann, and others, which consists in keeping the manure compactly heaped and well watered. Both heaping and watering tend to prevent the penetration of air and thus check the destructive aerobic fermentation. This method is used to a considerable extent in parts of France and Germany and is fully discussed by Ringelmann. A cistern is provided into which drain all the liquids from the stables, and the manure heap is watered by pumping the liquid manure from the cistern from time to time.

It is the writer's intention here merely to point out that the disposal of manure on the platform maggot trap is but a slight modification of the method just mentioned. Figure 4 differs from a diagram given by Ringelmann only in the platform and in the outlets through which the drowned larvæ may be washed into the cistern. Here is shown the cistern in which the liquid manure collects. Watering with the liquid manure adds to the heap the valuable constituents of the urine and promotes the anaerobic fermentation. If it is true, as just suggested, that lack of oxygen and the presence of carbon dioxid render the manure unfavorable for the development of the larvæ, it follows that compact heaping and watering, by excluding air and increasing the moisture content, also insure the greatest percentage of migration. As a matter of fact, compactness and high moisture content are the very factors which make the maggot trap most effective, whether the explanation is to be found in the temperature, or moisture, or lack of oxygen.

CONCLUSIONS.

In this paper we have described the structure of, and the method adopted in using, a platform maggot trap. All the manure from a stable in which three horses were kept was stored on this platform. The results obtained during August and September seemed to show that at least 98 per cent of the larvæ breeding in this manure were destroyed. Fly counts made before and after the trap was installed indicated an average reduction of from 67 to 76 per cent. That the reduction of flies did not correspond to the percentage of larvæ destroyed was probably due to the presence of several other breeding places well within the range of flight.

Two difficulties were experienced in the practical working of the trap, viz, the accumulation of a certain amount of straw and débris on the floor under the platform and the breeding of mosquitoes in the water used to drown the fly larvæ. It was also found that low air temperatures hinder migration and consequently decrease the efficiency of the trap.

Among the merits of the maggot trap were mentioned (1) the comparatively small initial cost and absence of money outlay necessary for its maintenance, (2) the very small amount of additional time or labor required in its operation, (3) the ease with which wagons or manure spreaders can be loaded from the platform, and (4) its adaptability for use at stables where the daily production of manure is large. Finally, it is suggested that the same conditions which render the trap most effective are the ones which tend to preserve the value of the manure.

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